PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-045510

(43)Date of publication of application : 14.02.1995

(51)Int.Cl. H01L 21/027
G03F 7/40

(21)Application number : 05-192151

(22)Date of filing : 03.08.1993

(71)Applicant : HITACHI LTD

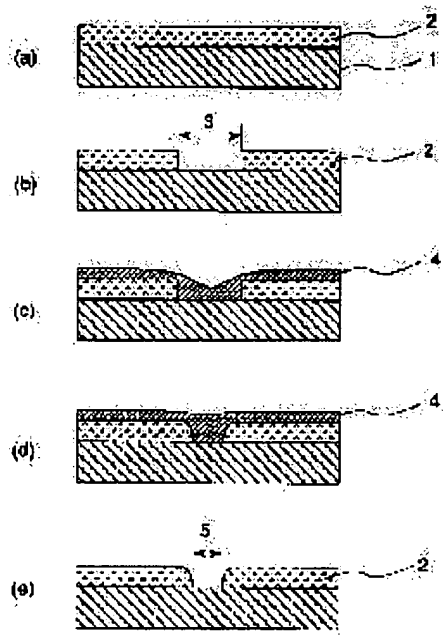
(72)Inventor : HASEGAWA NORIO
HAYANO KATSUYA

(54) PATTERN FORMING METHOD

(57)Abstract:

PURPOSE: To prevent the sag of a resist pattern side wall and the decrease of dimension controllability, by a method wherein a resist pattern is formed, the whole surface is coated with resin which does not mingle with resist, heat flow of the resist is generated by heat treatment, and then the resin spread on the resist is eliminated.

CONSTITUTION: Resist 2 is spread on a substrate 1 to be worked. Resist whose main component is positive type novolak system resin is used. The resist in a desired part is selectively eliminated by using ordinary lithography. Water-soluble resin 4 is spread on the whole surface, and then heat-treated at a temperature higher than or equal to the softening temperature of the resist. The water- soluble resin 4 is eliminated by rinsing.



LEGAL STATUS

[Date of request for examination] 18.01.1999

[Date of sending the examiner's decision of rejection] 13.02.2001

[Kind of final disposal of application other than

the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3218814
[Date of registration]	10.08.2001
[Number of appeal against examiner's decision of rejection]	2001-03721
[Date of requesting appeal against examiner's decision of rejection]	12.03.2001
[Date of extinction of right]	

* NOTICES *

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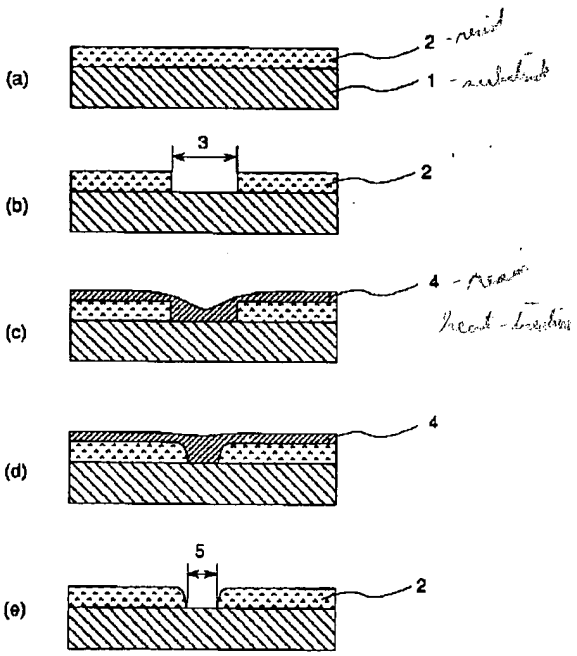
DRAWINGS

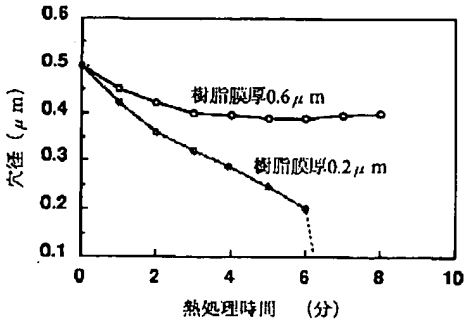
[Drawing 1]

図1



[Drawing 2]

図2



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the manufacture approach of a semiconductor device, and relates to the micro-processing approach of the component by the lithography method especially.
[0002]
[Description of the Prior Art] In recent years, detailed-ization of a component progresses and much more detailed-ization is demanded from lithography. Compared with the solution characteristic of image of a stepper to a wiring pattern, detailed-izing is difficult for especially the hole pattern for electrode formation, and development of a detailed-ized technique is needed. The detailed-ized method of a hole pattern is heat-treated at the temperature more than resist softening temperature after resist pattern formation, and has the approach of micrifying a pattern by heat floating of a resist as indicated by JP,1-307228,A. However, by this approach, the angle of inclination of a resist pattern side attachment wall became gently-sloping, and there were troubles, like the point that sufficient mask operation is not acquired by the next substrate processing, and a dimension controllability are bad.
[0003]
[Problem(s) to be Solved by the Invention] The technical problem of this invention is to offer the micrifying approach of a pattern without whom of a resist pattern side attachment wall, and lowering of a dimension controllability which is the trouble of the above-mentioned conventional technique.
[0004]
[Means for Solving the Problem] The above-mentioned technical problem applies to the whole surface the resin (water soluble resin etc.) which is not mixed with said resist after resist pattern formation, performs heat treatment and makes heat floating of a resist cause after that. Then, it is attained by the process which removes the resin applied on the resist.
[0005]
[Function] Since heat floating is made to cause after applying resin on a resist pattern, the resin buried in the resist serves as a stopper of resist floating, and pattern crushing of floating depended for carrying out too much can be prevented. Moreover, who of a resist pattern side attachment wall can prevent.
[0006]
[Example] Hereafter, drawing explains the first example of this invention. Drawing 1 is the sectional view showing the process of this invention. As shown in drawing 1 (a), the resist 2 was applied on the processed substrate 1. Here, the resist which uses the resin of the novolak system of a positive type as a principal component was used. Next, as shown in drawing 1 (b), the usual lithography removed the resist of a desired part selectively. Next, as shown in drawing 1 (c), water-soluble resin 4 was applied to the whole surface. Next, as shown in drawing 1 (d), it heat-treated at the temperature more than the softening temperature of a resist. Next, as shown in drawing 1 (e), rinsing removed water-soluble resin 4.
[0007] The resist clearance field 5 which micrified the resist clearance field 3 formed with lithography according to the above process was able to be formed. the flat-surface configuration of the micrified

pattern -- a hole pattern and a line -- it is a pattern etc. Although the resist which uses the resin of the novolak system of a positive type as a principal component was used for the resist 2, it can use, if it is the ingredient with which negative resist and a principal component cause heat floating, such as a polyisoprene-rubber system, an epoxy system, a polystyrene system, and an acrylate system. There is no need that resin 4 is also not necessarily water solubility. It is required not to mix both, when resin 4 is applied on a resist 2. Resin 4 can also be replaced with the inorganic film. Moreover, it is also required in the case of clearance of resin 4 not to melt a resist 2.

[0008] The approach of clearance of resin 4 is not restricted to wet. Dry type is sufficient. For example, the approach of removing as pretreatment of the dry etching of a processed substrate is also possible.

[0009] Moreover, it is desirable that the softening temperature of resin 4 is higher than a resist 2. The temperature which makes heat floating of the resist of the novolak system used here cause was 120 degrees C or more.

[0010] The relation between heat treatment time amount and a bore diameter is shown in drawing 2 . The novolak system resist was used for the resist 2, and thickness was set to 1 micrometer. Spreading thickness was set to 0.6 micrometers and 0.2 micrometers at resin 4 using polyvinyl alcohol, heat treatment time amount was changed, and change of a bore diameter was investigated. Heat treatment temperature was made into 150 degrees C. the bore diameter before heat treatment -- 0.5 micrometers it is .

[0011] the time of heat treatment time amount being 3 minutes -- the thickness of polyvinyl alcohol -- 0.6 micrometers it is -- a case -- a bore diameter -- the case of about 0.4 micrometers and polyvinyl alcohol where thickness is 0.2 micrometers -- a bore diameter -- about 0.3 micrometers It became. However, when it carried out, it considered as 6 minutes and the thickness of polyvinyl alcohol was [the increase of heat treatment time amount, or] 0.6 micrometers further, the bore diameter did not have the time and change for about 0.4 micrometers and 3 minutes. Although the bore diameter was set to about 0.2 micrometers when the thickness of polyvinyl alcohol was 0.2 micrometers, in the hole upper part, the phenomenon in which a breadth hole side attachment wall flagged [a bore diameter] was seen. In such the condition, sufficient mask operation was not acquired in processing of a substrate, but it was a problem. Heat treatment time dependency of a bore diameter was able to be made small by thickening thickness of polyvinyl alcohol. Moreover, as a result of examining various conditions, when thickness of a resist 2 was set to 1, the result with the thickness of resin 4 especially good at 0.3-1.0 micrometers was obtained. Moreover, although there is an inclination for a bore diameter to become small when heat treatment temperature is made high, becoming small too much can be prevented by forming a resin layer. Although polyvinyl alcohol was used for resin 4 here, as a result of experimenting using other resin, the data in which the almost same inclination is shown were obtained.

[0012]

[Effect of the Invention] According to this invention, the detailed pattern beyond the resolution limit can form by easy processing. Especially, detailed-ization of the hole pattern for the electrode ejection of the difficult VLSI of detailed-izing can be realized, and it becomes possible to realize manufacture of a VLSI using optical lithography.

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CLAIMS

[Claim(s)]
[Claim 1] the process which forms a resist pattern on a substrate, and the whole surface -- or the pattern formation approach characterized by including the process which forms in a part the resin which is not mixed with said resist, a heat treatment process, and the process which removes the resin which is not mixed with said resist.
[Claim 2] The pattern formation approach that the resin which is not mixed with said resist in claim 1 is water soluble resin.
[Claim 3] The pattern formation approach which is the temperature beyond the limitation that said heat treatment process causes heat floating of said resist in claim 1, or the temperature more than softening temperature.
[Claim 4] The pattern formation approach that a resist pattern is a hole pattern.

[Translation done.]

(19) JAPANESE PATENT OFFICE

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(11) Publication number: 07045510 A

(43) Date of publication of application: 14.02.95

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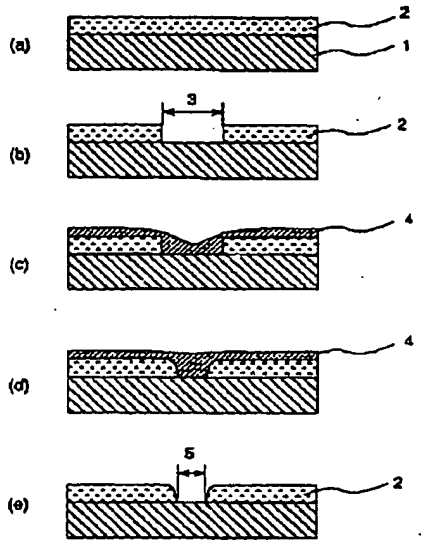

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平7－45510

(43)公開日　平成７年(1995)２月14日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ		技術表示箇所
Ｈ０１Ｌ　21/027					
Ｇ０３Ｆ　7/40	５０１	7124－2Ｈ			
		7352－4Ｍ	Ｈ０１Ｌ　21/ 30	５６６	
		7352－4Ｍ		５６８	

審査請求　未請求　請求項の数４　ＯＬ　（全３頁）

(21)出願番号　特願平5－192151

(22)出願日　平成５年(1993)８月３日

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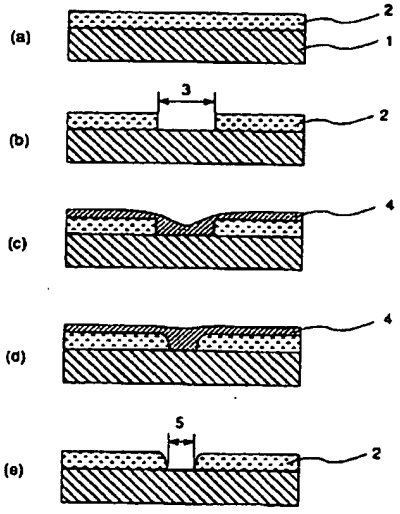
(54)【発明の名称】　パタン形成方法

(57)【要約】

【構成】レジストパタン形成後、樹脂４を全面に塗布した後、熱処理によりレジスト２を流動させ、パタンを微細化する。

【効果】樹脂塗布後にレジストの熱流動を起こさせるため、流動のしすぎが防止でき、寸法の安定化が図れる。微細化の困難な超ＬＳＩの電極取り出し用の穴パタンの微細化が実現できる。

図１



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【特許請求の範囲】

【請求項1】基板上にレジストパタンを形成する工程と、全面に或いは一部分に前記レジストに混じらない樹脂を形成する工程と、熱処理工程と、前記レジストに混じらない樹脂を除去する工程とを含むことを特徴とするパタン形成方法。

【請求項2】請求項1において、前記レジストに混じらない樹脂が水溶性樹脂であるパタン形成方法。

【請求項3】請求項1において、前記熱処理工程が前記レジストの熱流動を起こす限界以上の温度、あるいは軟化点以上の温度であるパタン形成方法。

【請求項4】レジストパタンが穴パタンであるパタン形成方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、半導体装置の製造方法に係り、特に、リソグラフィ法による素子の微細加工方法に関する。

【0002】

【従来の技術】近年、素子の微細化が進み、リソグラフィに対し、よりいっそうの微細化が要求されている。特に、電極形成用の穴パタンは、ステッパの解像特性から、配線パタンに比べて微細化が困難であり、微細化技術の開発が必要となっている。穴パタンの微細化法は特開平1－307228 号公報に記載されているように、レジストパタン形成後、レジスト軟化点以上の温度で熱処理し、レジストの熱流動によりパタンを微小化する方法がある。しかし、この方法では、レジストパタン側壁の傾き角がなだらかになり、次の基板加工で十分なマスク作用が得られない点や、寸法制御性が悪いなどの問題点があった。

【0003】

【発明が解決しようとする課題】本発明の課題は、上記従来技術の問題点である、レジストパタン側壁のだれや、寸法制御性の低下が無い、パタンの微小化方法を提供することにある。

【0004】

【課題を解決するための手段】上記課題は、レジストパタン形成後、全面に前記レジストと混ざりあわない樹脂（水溶性樹脂など）を塗布し、その後、熱処理を行いレジストの熱流動を起こさせる。その後、レジスト上に塗布した樹脂を除去する工程により達成される。

【0005】

【作用】レジストパタン上に樹脂を塗布してから熱流動を起こさせるため、レジスト内に埋まった樹脂が、レジスト流動のストッパとなり、流動のしすぎによるパタンつぶれ等が防止できる。又、レジストパタン側壁のだれも防止できる。

【0006】

【実施例】以下、本発明の第一の実施例を図により説明

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する。図1は本発明の工程を示す断面図である。図1（a）に示すように、被加工基板1上にレジスト2を塗布した。ここでは、ポジ型のノボラック系の樹脂を主成分とするレジストを用いた。次に、図1（b）に示すように、通常のリソグラフィにより所望の部分のレジストを選択的に除去した。次に、図1（c）に示すように、全面に水溶性の樹脂4を塗布した。次に、図1（d）に示す様にレジストの軟化点以上の温度で熱処理した。次に、図1（e）に示すように、水洗により水溶性の樹脂4を除去した。

【0007】以上の工程により、リソグラフィで形成したレジスト除去領域3を微小化したレジスト除去領域5を形成することが出来た。微小化したパタンの平面形状は、穴パタン，線状パタンなどである。レジスト2にはポジ型のノボラック系の樹脂を主成分とするレジストを用いたが、ネガ型レジストや主成分がイソプレンゴム系，エポキシ系，ポリスチレン系，アクリレート系等、熱流動を起こす材料であれば用いることが出来る。樹脂4も必ずしも水溶性である必要は無い。レジスト2上に樹脂4を塗布した時に両者が混ざり合わないことが必要である。樹脂4は無機膜と置き換えることも可能である。また、樹脂4の除去の際にレジスト2を溶かさないことも必要である。

【0008】樹脂4の除去の方法は湿式に限らない。乾式でも良い。例えば、被加工基板のドライエッチングの前処理として除去する方法も可能である。

【0009】また、樹脂4の軟化点がレジスト2よりも高い事が好ましい。ここで使用したノボラック系のレジストの熱流動を起こさせる温度は１２０℃以上であった。

【0010】図2に熱処理時間と穴径の関係を示す。レジスト2にノボラック系レジストを用い、膜厚を1μmとした。樹脂4にはポリビニルアルコールを用い、塗布膜厚を0.6μmと0.2μmとし、熱処理時間を変え穴径の変化を調べた。熱処理温度は１５０℃とした。熱処理前の穴径は0.5μm である。

【0011】熱処理時間が3分の時、ポリビニルアルコールの膜厚が0.6μm の場合、穴径は約0.4 μm、ポリビニルアルコールの膜厚が0.2μmの場合、穴径は約0.3μm となった。しかし、さらに熱処理時間を増やし6分とした時、ポリビニルアルコールの膜厚が0.6μmの場合、穴径は約0.4 μmと3分の時と変化がなかった。ポリビニルアルコールの膜厚が0.2μmの場合、穴径は約0.2μmとなったが、穴上部では穴径が広がり穴側壁がだれる現象がみられた。このような状態では基板の加工において十分なマスク作用が得られず問題であった。ポリビニルアルコールの膜厚を厚くすることにより穴径の熱処理時間依存性を小さくすることが出来た。又、種々の条件について検討した結果、レジスト2の膜厚を1とした時、樹脂4の膜厚は0.3～1.

０μｍで特に良好な結果が得られた。又、熱処理温度を高くすると穴径が小さくなる傾向があるが、樹脂層を形成することにより、小さくなり過ぎることは防止できる。ここでは樹脂４にポリビニルアルコールを用いたが、その他の樹脂を用いて実験した結果、ほぼ同様の傾向を示すデータが得られた。

【００１２】

【発明の効果】本発明によれば、解像限界を超えた微細なパターンが簡単な処理により形成できる。特に、微細化の困難な超ＬＳＩの電極取り出し用の穴パタンの微細

化が実現でき、超ＬＳＩの製造を光リソグラフィを用い実現することが可能となる。

【図面の簡単な説明】

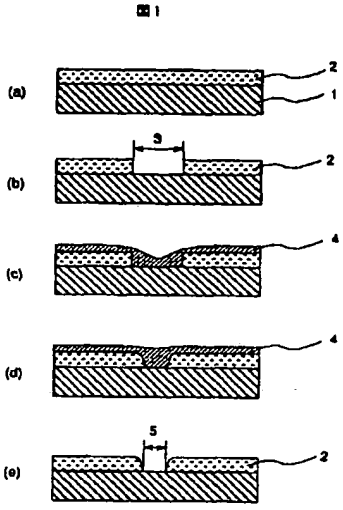
【図１】本発明の実施例のパタンの形成工程を示す断面図。

【図２】本発明の効果を示すグラフ。

【符号の説明】

１…被加工基板、２…レジスト、３…レジスト除去領域、４…樹脂、５…微小化したレジスト除去領域。

【図１】



【図２】